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CRUISE REPORT

CAGE-OA February Cruise to the western Svalbard margin and the western Barents Sea slope

on R/V Helmer Hanssen, February 8th – February 15th, 2016

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1. Summary

From the afternoon of February 8th to the late morning of February 15th 2016, CAGE at the Department of Geology Uit, the Arctic University of Norway, arranged a scientific cruise aimed at investigating water masses and planktonic faunas at the western Svalbard margin and western Barents Sea slope, also visiting methane seep sites off Vestnesa Ridge, Prins Karls Forland (PKF) and in Storfjorden Trough on R/V “Helmer Hanssen”. Investigated areas were (in order of visiting sites on the cruise): PKF, Storfjorden Fan, Storfjorden Trough, Bjørnøya Trough Mouth Fan, north, mid and south and the slope off Troms (off Malangen) (Figs. 1 and 2). Seep sites at Vestnesa Ridge were abandoned because of bad weather conditions. The scientific sampling was done within the framework of several ongoing projects at the Department of Geology, University of Tromsø: “CAGE - Centre for Arctic Gashydrate, Environment and Climate”.

A total of 1 boxcore, 8 plankton net (4 multinet and 4 plankton net) casts and 14 CTD (conductivity-temperature-depth) casts were performed along the route from western Svalbard to Norway along the western Barents Sea slope. Data were also collected in Storfjorden Trough and Storfjorden – no sea ice yet.

Chirp profiles and multibeam lines were acquired during transits and in Storfjorden.

2. Background

During the cruise, data were collected for CAGE projects:

The overall purpose is to study and reconstruct the emission of methane through time in relation to past climate change. The purpose is also to study the exchange of Atlantic surface water and polar water along the Svalbard margin compared to natural variations in CO₂ and climate in the past. Furthermore, the preservation of calcareous planktic foraminifera in relation to acidification of the water column, sediment surface in the present in relation to anthropogenic influence and in the past under natural climate variability. We aim to collect gravity and boxcores and plankton net samples and CTD records and water samples at various locations: Vestnesa Ridge, northwest Svalbard, Storfjorden Trough, and western Barents Sea margin.

3. Objectives

The objectives of the cruise were:

- To collect plankton samples and CTD and water samples from the entire planned study areas with the purpose of studying the content of living and subrecent planktic foraminifera and the conditions of their shells in order to elucidate the effect of CaCO₃ preservation (ocean acidification) on the living and recently dead planktic foraminifera. Water samples and CTD for water properties and chemistry. In Storfjorden also brine overflow will be studied by CTD and water sampling.
- To retrieve gravity-cores from active pockmarks of methane gas seepage in order to investigate foraminiferal-fauna assemblages in past and present environments affected by release of methane and reconstruct variations in activity of methane seeping in relation to climate and oceanographic change.
- Plankton net sampling above flares on the shelf off PKF, Vestnesa and in Storfjorden Trough to record effects of seeping on planktic foraminifera and their shells and on productivity of planktic organisms in general.

- To study the brine formation in Storfjorden during winter conditions with CTD and water sampling (not much sea ice in Storfjorden in February this year) - part of ongoing projects since 2002.

4. Participants

Scientific crew:

Name	Affiliation
Rasmussen, Tine Lander (Professor; chief scientist)	UiT
Kamila Sztybor (phd-student; co-chief scientist)	UiT
Steinar Iversen (Engineer)	UiT
Mohamed Ezat (post doc)	UiT
Julie Meilland (Post doc)	Univ. Nantes, UiT
Siri Ofstad (phd-student)	UiT
May Baker (master student)	UiT

UiT = Uit, the Arctic University of Norway

5. Equipment

Acoustic equipment

- Kongsberg Maritime EM 300 multibeam echo sounder
- EdgeTech 3300-HM hull-mounted sub-bottom profiler ("Chirp"); 4*4 arrays
- Kongsberg Maritime EK60 splitbeam echosounder (18, 38 and 120 kHz)

Sediment sampling

- Giant box corer (50*50*50 cm³)

Water properties:

- CTD (Seabird 911 Plus) with compact rosette with water samplers

Plankton net:

- Type WP-2 net from HydroBios, mesh-size 64 microns
- MultiNet type Midi-25 m² from HydroBios, mesh-size 64 microns

6. Methods

Sediment sampling

Sediment sampling was done by box coring to retrieve surface samples and sub-recent samples. Three surface samples (0-2 cm) were scooped off the surface, and two sub cores were taken. The samples were frozen and kept for later analyses of planktic and benthic foraminiferal faunas.

Plankton sampling

Plankton nets were cast at previous multi-core/box core stations and CTD-stations for capture of planktic foraminifera for investigations of ocean acidification and for fauna studies. Mesh size

were 90 or 64 micron. Samples were preserved in 96% alcohol with Rosa Bengal and buffered with Disodium Hydrogen Phosphate and Sodium Hydrogen Phosphate.

Water properties

The water properties – temperature, salinity – were measured at every sampling station and at regular intervals using a *Seabird 911 Plus* CTD. Data collection was performed during downcasts at a speed of approx. 1.0 m/s. The data of selected CTD stations were used for records of modern water mass properties records for the paleo-studies and studies of living planktic and benthic foraminifera and to calculate sound-velocity profiles for calibrating the multibeam echo sounder system. Water samples were taken on a regular basis for water chemistry analyses in Uit/HI labs.

Acoustic investigations

Seafloor mapping:

Swath-bathymetry surveys were carried out using a *Kongsberg Maritime EM 300 multibeam echo sounder*. Sound-velocity profiles of the water column for calibrating the equipment were recorded from CTD casts where necessary. Swath-bathymetry data was also collected during the transits between working areas and stations. The equipment worked well during the acquisition and the data are of good quality. Some preliminary data cleaning was performed using the software programme *Neptune* version 6.6.

Seismic profiling:

High-resolution seismic profiles (Chirp), using an *EdgeTech 3300-HM* hull-mounted sub-bottom profiler, were collected along the ship tracks during the swath-bathymetry data acquisition during transits. Pulse mode and shot rate were varied, depending on the water depth. Soft start of the chirp was performed well out over the shelf edge on day two, starting with 1% of the total effect, followed by a doubling of the effect every minute. The equipment worked well and the data are generally of good quality.

Echo-sounder flare observation

The echo-sounder installed on RV Helmer Hanssen was planned to be used to detect gas bubbles rising from seep sites at the seafloor off PKF, Vetsnesa and in Storfjorden Trough.

7. Preliminary results and outcome of the cruise

Scientific goals:

In general, because of poor weather conditions the northern leg of this survey (PKF and at Vestnesa) were abandoned. In Storfjorden Trough part of the program was abandoned because of bad weather. Instead, we did a small survey of inner Storfjorden with CTD revisiting stations from last summer. We found extremely homogeneous conditions in the water column, indicating that Storfjorden may be well pre-conditioned for brine formation this year. On the transit south some stations were abandoned because of bad weather, or part of the program at stations were abandoned because of bad weather. We thus arrived to the southern Barents Sea and Norwegian margin sooner and added two stations south of Tromsø: Malangen and off Lofoten/Vesterålen.

In essence, about half the planned stations were abandoned due to poor weather conditions. For the remaining stations some data were collected, but only one BC out of 5

planned were taken. Two new stations along the Norwegian margin replaced the northernmost part that was given up. 14 CTD casts were performed, 4 multinet- and 4 plankton net tows, and 1 box core were retrieved in total for the projects. CTD and water samples were taken to analyse water properties and chemistry at plankton stations and box core stations for surface sediment and living benthic foraminifera analyses for the CAGE projects. Plankton samples were taken to study the impact of ocean acidification on the shells of the specimens and to study seasonal changes in species distribution and depth habitats. Bottom samples to investigate post-mortem changes in planktic foraminifera and changes in living (and dead shells) of benthic foraminifera.

The collected material will be analysed at the Department of Geology, UiT, the Arctic University of Norway, as part of ongoing research (seniors, researchers, Post docs, Phds) and also form a basis for future master, PhD and post doc studies a.o.